Name: ____________________________ Date: ______________

A2CC Solving Exponential Equations Using Logarithms

WarmUp:

1) The expression $\log_4(x^2-16)-\log_4(x+4)$, assuming $x \neq 4$, can be simplified to

(a) $2\log_4 x - 12$

(b) $\log_4(x-4)$

(c) $\log_4(x+4)$

(d) $\log_4 x - 1$

Earlier in this unit, we used the **Method of Common Bases** to solve exponential equations. This technique is quite limited, however, because it requires the two sides of the equation to be expressed using the same base. A more general method utilizes our calculators and the third logarithm law:

THE THIRD LOGARITHM LAW

$$\log_b\left(a^x\right) = x\log_b a$$

***Exercise* #1:** Solve: $4^x = 8$ using (a) common bases and (b) the logarithm law shown above.

(a) Method of Common Bases

(b) Logarithm Approach

The beauty of this logarithm law is that it removes the variable from the exponent. This law, in combination with the logarithm base 10, the **common log**, allows us to solve almost any exponential equation using calculator technology.

***Exercise* #2:** Solve each of the following equations for the value of *x*. Round your answers to the nearest *hundredth*.

(a) $5^x = 18$ (b) $4^x = 100$ (c) $2^x = 1560$

These equations can become more complicated, but each and every time we will use the logarithm law to transform an exponential equation into one that is more familiar (linear only for now)

***Exercise* #3:** Solve each of the following equations for *x*. Round your answers to the nearest *hundredth*.

(a) $6^{x+3} = 50$ (b) $(1.03)^{\frac{x}{2}-5} = 2$

As a final discussion, we return to evaluating logarithms using our calculator. Many modern calculators can find a logarithm of any base. Some still only have the common log (base 10) and another that we will soon see. But, we can still express our answers in terms of logarithms.

***Exercise* #4:** Find the solution to each of the following exponential equations in terms of a logarithm with the same base as the exponential equation.

(a) $4(2)^x - 3 = 17$ (b) $17(5)^{x/3} = 4$

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SOLVING EXPONENTIAL EQUATIONS USING LOGARITHMS HOMEWORK

1. Which of the following values, to the nearest *hundredth*, solves: $7^x = 500$?

(1) 3.19 (3) 2.74

(2) 3.83 (4) 2.17

2. The solution to $2^{x/3} = 52$, to the nearest *tenth*, is which of the following?

(1) 7.3 (3) 11.4

(2) 9.1 (4) 17.1

3. To the nearest *hundredth*, the value of *x* that solves $5^{x-4} = 275$ is

(1) 6.73 (3) 8.17

(2) 5.74 (4) 7.49

4. Solve each of the following exponential equations. Round each of your answers to the nearest *hundredth*.

(a) $9^{x-3} = 250$ (b) $50(2)^x = 1000$ (c) $5^{x/10} = 35$

5. Solve each of the following exponential equations. Be careful with your use of parentheses. Express each answer to the nearest *hundredth*.

(a) $6^{2x-5}=300$ (b) $\left(\frac{1}{2}\right)^{\frac{x}{3}+1}=\frac{1}{6}$ (c) $500(1.02)^{\frac{x}{12}}=2300$

6. Find the solution to the general exponential equation $a(b)^{cx}=d$, in terms of the constants a, c, d and the logarithm of base b. Think about reversing the order of operations in order to solve for x.